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(54) **Injection moulding method and apparatus.**

(57) An apparatus (10) for assisting in the removal of an injection-moulded article (24) from the core (22) of a mould is disclosed in combination with a moulding machine in which the mould core (22) is fixed to a moving platen (18) and an ejector mechanism (28) is supplied which mechanically removes the article (24) from the core (22). The assisting apparatus includes a conduit (32) leading to a surface (34) of the mould core which defines the bottom (26) of the article formed. A piston (40) and cylinder (36) is connected to the conduit (32), the interior of the cylinder (36) being dimensioned to be approximately equal to the interior volume of the article (24) formed.

The cylinder (36) is fixed with respect to the platen (18) while the piston (40) is fixed with respect to the ejector apparatus (28). As the ejector (28) moves with respect to the mould core (22) so as mechanically to strip the moulded article (24) from the core (22), the piston (40) moves within the cylinder (36) which is filled with air at approximately 1 atmosphere, thereby causing the air within the cylinder (36) to be introduced into the conduit (32) and thus into the void developing between the bottom (26) of the formed article (24) and the mould core (22), thereby preventing deformation of the formed article (24).

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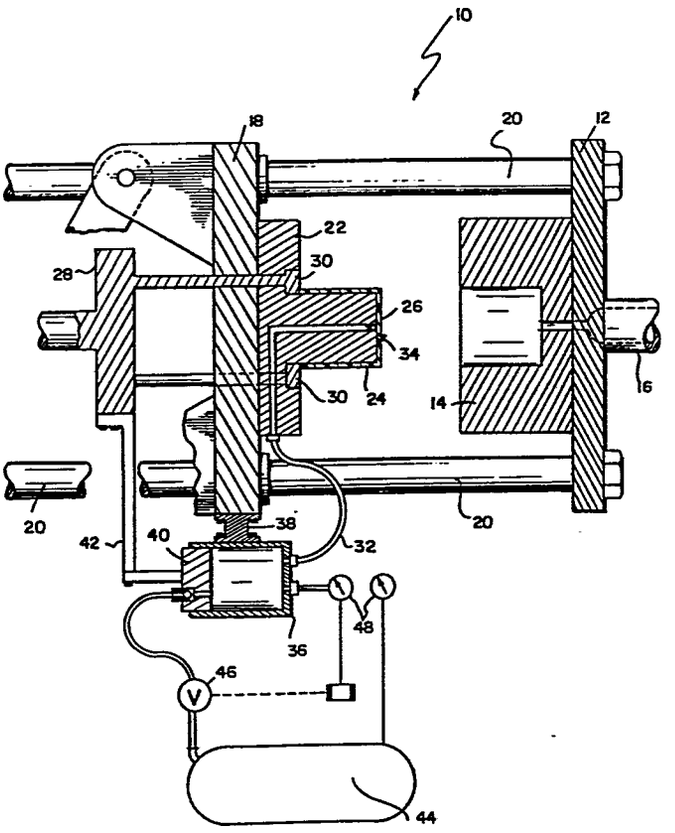
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TITLE

INJECTION MOULDING METHOD AND APPARATUS

DESCRIPTION

The present invention is directed generally to moulding machines and processes of moulding thermoplastics. The invention is directed particularly to a method and apparatus for assisting in the process of removing moulded articles from a mould so as to retain features created in the moulding operation.

The injection moulding of thermoplastics is a well-known process by which plastics generally in granular, pellet, or powdered form are first heated to a viscous melted state and then injected under high pressure into a mould where the plastic cools to a solid shape conforming to the contours of the mould walls. The resulting articles are usually finished products requiring no further work prior to assembly into or use as finished products.

In general, a mould comprises a mould

cavity and a mould core, the moulded article being formed between the opposed core and cavity when the viscous melted thermoplastic is injected into the space between the core and cavity. When the article is sufficiently cool so as to retain its shape, the core and cavity separate one from the other and the article is then removed, usually with the aid of an ejector means, from the space between the core and cavity. The ejector means may take various forms.

An ejector means can comprise an ejector plate which is movable with respect to the moving platen of the moulding machine to which is mounted the mould core. A series of ejector pins are positioned on the ejector plate and held in place by an ejector retainer plate. As the ejector system moves forward with respect to the moving platen, the pins contact the previously moulded articles adhering to the mould core at designated points, knocking them free to drop down out of the space between the mould core and cavity.

In other situations, the ejector means employed can comprise a core pin which is usually centred on the article formed in the mould and surrounded by an ejector sleeve.

When ejecting a narrow rib or part edge, it is also possible to use a thin ejector blade. Another common method of ejection is to have an entire plate move forward over the stationary core to mechanically remove the parts. The plate is usually called a stripper plate, and the moulds with which they are used are often referred to as stripper plate moulds.

The present invention is intended to be employed with any ejector means of which those previously discussed are merely illustrative.

The cooling of the mould, and hence the article in the mould, so as to retain its shape is easily achieved by having chilled water circulate through interconnecting drilled holes in the individual mould plates, and particularly near the core, the water carrying away the unwanted heat. The cooling portion of the complete injection cycle typically represents the major amount of time employed in the moulding sequence. Since a shorter moulding cycle will result in the creation of more moulded articles per unit time per machine, it is generally desirable to cool no more than is necessary to have the article retain its shape.

With some articles, particularly with straight wall or reverse draft wall containers, the cooling cycle must be particularly long in order to permit the formed article to be removed from the core. The walls of the container surround the core in such a fashion as to make the removal of the article from the core mechanically difficult. In a straight wall container, the stripping of the container from the core tends to create a vacuum inside the container since the core is retreating in piston-like fashion down a cylinder defined by the container whose end wall is closed by the bottom of the container. The vacuum thus created between the core and the bottom of the container causes the bottom of the container to deflect inwardly and, upon occasion, rupture. While a longer cooling cycle tends to strengthen the bottom of the container, the moulding cycle is usually so slow as to render the manufacture of such items uneconomical.

It has been suggested and attempted to introduce pressurized air into the space between the core face which defines the bottom of the container and the bottom of the container, but this introduction of pressurized air has caused its own problems. Namely, the pressure has caused the bottom of the

container to bow outwardly and, upon occasion, destruct.

It is therefore an object of the present invention to provide a means for assisting in the removal of a moulded article from a mould in such a manner as to retain the features of the article created in the moulding operation. It is a further object of the present invention to provide an apparatus for assisting in the removal of straight wall containers from the core such that the bottom of the container is unaffected by the removal of the container from the core.

The invention provides an apparatus for assisting in the removal of an injection-moulded article (24) from the core (22) of the mould in which the article was formed, the mould core being movable with respect to an ejector means (28) for mechanically removing the moulded article from the core, the apparatus comprising

a conduit (32) leading to a surface (34) of the mould core against which the moulded article is formed, and

Means (36,40) for introducing into the conduit a measured volume of fluid at a rate controlled by the rate of relative movement between

the core and the ejector means. Where the article being moulded is a straight wall container, the conduit advantageously leads to the surface of the core which defines the bottom of the container.

In a preferred embodiment, the means for introducing fluid into the conduit takes the form of a piston in a cylinder, the interior of the cylinder being connected to the conduit. The piston is connected to either of the core and ejector means, with the cylinder being connected to the other of those two elements. As the platen to which the mould core is mounted and the ejector means move with respect to each other, the piston is displaced within the cylinder, causing the fluid to be transmitted through the conduit. Where the volume of the cylinder included by the piston is approximately equal to the volume of the container being moulded, the amount of fluid introduced between the end of the core and the bottom of the container is such as will maintain that space at a constant pressure, preferably approximately 1 atmosphere, thereby preventing the bottom of the container from being distorted.

The fluid is preferably air, introduced at a pressure of about 1 atmosphere, although the pressure

can exceed that to perhaps as high as 1.4 atmospheres. Where an elevated pressure is employed, a chamber of variable volume such as the piston and cylinder arrangement previously described is connected to a means for supplying air at the superatmospheric pressure to the conduit at a point in the moulding cycle other than during part ejection.

DRAWINGS

The drawing is a schematic diagram, partially in section, of a moulding apparatus constructed in accordance with the present invention.

The drawing shows an ejection-moulding machine 10 comprising a stationary platen 12 to which is fixed the mould cavity 14 and the nozzle 16 of the injection unit which supplies the mould with the viscous melted plastics at the desired time. A moving platen 18 moves with respect to the fixed platen 12 on tie rods 20 by means of a clamp unit (not shown). Any of various designs of clamp units may be employed of mechanical, hydraulic or hydromechanical design. The core of the mould 22 is fixed to the moving platen 18 and reciprocates with respect to the mould cavity 14. When the mould cavity 14 and core 22 abut, there is defined

therebetween a space into which the viscous thermoplastic is injected, forming a moulded article shown in Figure 1 as a straight wall cylindrical container 24 having a container bottom 26. When the article 24 is formed, and sufficiently cooled, the core 22 and cavity 14 separate to the position illustrated and an ejector means 28 moves toward the moving platen 18, thereby mechanically removing the moulded article 24 from the core 22 by means of elements 30 shown in the drawing as a stripper ring.

In the present invention, there is provided a conduit 32 leading to surface 34 of the mould core 22 against which the moulded article 24 is formed. As shown the surface 34 defines the bottom 26 of the container. The conduit 32 is in turn connected to a cylinder 36 which is fixed to the moving platen 18 by an appropriate mounting means 38. A piston 40 is provided within cylinder 36, the piston being mechanically connected to the ejector means 28 by an appropriate linkage 42. As the ejector means 28 moves toward the movable platen 18, the piston 40 moves within cylinder 36, thereby causing any fluid within the cylinder 36 to be displaced from the cylinder into conduit 32 leading to the interface between the surface 34 of the mould core 22 and

the bottom 26 of the moulded article 24.

In accordance with the present invention, it is intended that the cylinder 36 would contain a fluid such as air at approximately atmospheric pressure. It is further intended that the dimensions of the cylinder 36 would be selected such that the volume swept out by the piston 40 moving through cylinder 36 would approximately equal the volume developing between surface 34 of mould 22 and the bottom of the container 26, in this way maintaining the bottom of container 26 undistorted.

It may be desirable that the air in container 36 be slightly above atmospheric pressure, in which case an appropriate means 44 such as a compressor may be employed to supply air at an elevated pressure to cylinder 36, the air being introduced into the cylinder 36 at a point in the injection cycle other than during the article ejection from the mould core. Appropriate valves 46 and pressure sensors 48 can be employed to carry out the intent of the present invention.

It is important to understand that the fluid being introduced between surface 34 of mould 22 and the bottom 26 of container 24 does not act to hydraulically remove the container 24 from the mould core 22. The

article 22 is mechanically ejected from the core by the ejector means 29 and the introduction of fluid is merely to ensure that the bottom 26 remains substantially undistorted during the article ejection.

CLAIMS

1. An apparatus for assisting in the removal of an injection-moulded article (24) from the core (22) of the mould in which the article was formed, the mould core being movable with respect to an ejector means (28) for mechanically removing the moulded article from the core, the apparatus comprising

a conduit (32) leading to a surface (34) of the mould core against which the moulded article is formed, and

means (36,40) for introducing into the conduit a measured volume of fluid at a rate controlled by the rate of relative movement between the core and the ejector means.

2. The apparatus of claim 1 wherein the article being moulded is a straight wall container, and said conduit leads to a surface of the core defining the bottom (26) of the container.

3. The apparatus of claim 2 wherein the means for introducing fluid into the conduit comprises a piston (40) in a cylinder (36), the interior of the cylinder being connected to the conduit.

4. The apparatus of claim 3 wherein the piston is connected to one of the core and ejector means,

and the cylinder is connected to the other of the core and ejector means.

5. The apparatus of claim 3 or 4 wherein the volume of the cylinder is approximately equal to the volume of the container being moulded.

6. The apparatus of any preceding claim wherein the fluid is air at a pressure of from 1 to 1.4 atmospheres.

7. The apparatus of claim 6 wherein the fluid is air at superatmospheric pressure and the means for introducing the fluid into the conduit further comprises means (44,46) for introducing air at the superatmospheric pressure to the conduit at a point in the moulding cycle other than during part ejection.

8. An injection-moulding machine having a moving platen (18), a mould core (22) mounted on the moving platen defining in part the space in which an article (24) is moulded, and an ejector means (28) movable with respect to the moving platen for mechanically removing a moulded article from the mould core, characterized in that the machine comprises

a source (36) of fluid at about atmospheric pressure,

a conduit (32) leading from a moulding space-defining surface (34) of the mould core to the

source of fluid, and

means (40) associated with said conduit for introducing a measured volume of said fluid to the moulding space-defining surface at a rate controlled by the relative motion between the moving platen and the ejector means.

9. An apparatus for assisting in the removal of an injection-moulded straight wall container (24) from the core (22) of the mould in which the container was formed, the mould core being fixed to a moving platen (18) and having a stripper ring (30) surrounding the core for mechanically removing the container from the core, the apparatus comprising

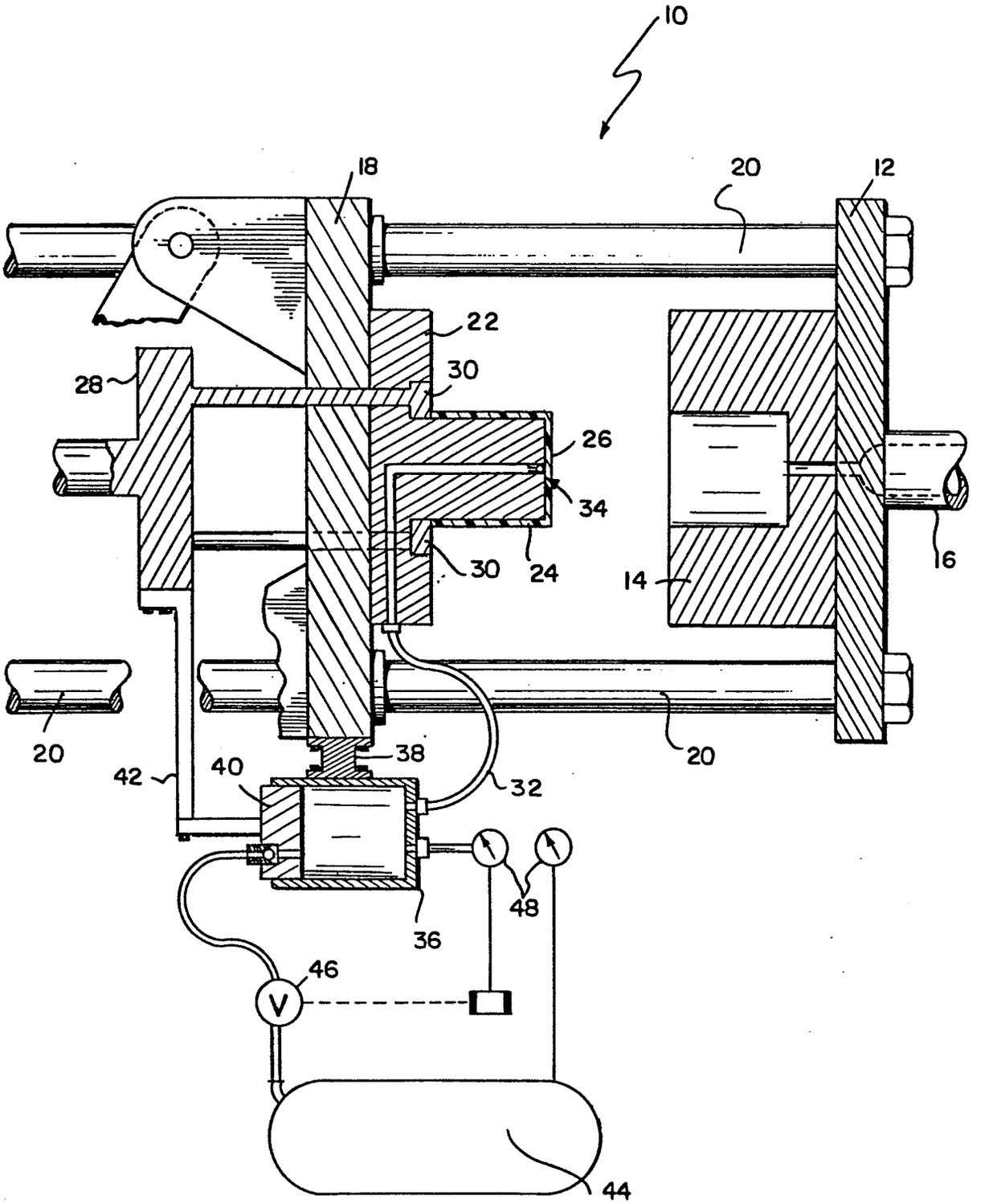
a conduit (32) leading to a surface (34) of the mould core defining the bottom (26) of the container, and a piston (40) in a cylinder (36), the interior of the cylinder being connected to the conduit, the cylinder being fixed to said platen, and the piston being fixed to said stripper ring, the volume of the cylinder included by the piston being approximately equal to the container, the cylinder being filled with air at a pressure of approximately 1 atmosphere, the relative movement between the mould core and the stripper ring causing the air within the cylinder to be introduced into the

conduit at a rate substantially equal to the rate at which a void develops between the bottom of the container and the mould core as the container is stripped from the mould core.

10. A method of assisting in the removal of an injection-moulded article (24) from the core (22) of the mould in which the article was formed, the mould core being attached to a platen (18) and having an ejector means (28) movable with respect to the platen for mechanically removing the moulded article from the core, the method comprising the steps of

providing a conduit (32) leading to a surface (34) of the mould core against which the moulded article is formed, and

introducing into the conduit a measured volume of fluid at about atmospheric pressure at a rate controlled by the rate of relative motion between the platen and the ejector means.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European Patent Office

0071343
Application number

EUROPEAN SEARCH REPORT

EP 82 30 3396.4

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 3)
A	FR - A - 2 076 587 (PLASTIMONDE) * claims 1 to 3; page 1, lines 9 to 14, 31 to 38; page 2, lines 1 to 9; page 3, lines 12 to 21; fig. 1, 2 * --	1,8,10	B 29 F 1/14
A	PLASTVERARBEITER, Vol. 30, No. 11, November 1979, Speyer am Rhein "Pneumatische Entformungshilfen beim Spritzgießen" pages 703 to 705 * page 705 * --	1,8,10	
A	DE - C - 1 145 783 (ANKERWERK GEBR. GOLLER) * fig. 1 to 4 * --	1	B 29 C 7/00 B 29 F 1/00
A	AT - B - 349 745 (KREMS-CHEMIE GMBH) * whole document * --	1	
A	DE - A - 2 324 212 (KRAUSS-MAFFEI AG) * claim 1; fig. * & US - A - 3 952 991 --	1	
A	FR - A - 1 139 182 (LES FILS DE N. CLERC) * fig. 1 to 3 * ----		

TECHNICAL FIELDS SEARCHED (Int.Cl. 3)

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A: technological background
O: non-written disclosure
P: intermediate document
T: theory or principle underlying the invention
E: earlier patent document, but published on, or after the filing date
D: document cited in the application
L: document cited for other reasons

&: member of the same patent family, corresponding document

X The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Berlin	27-09-1982	FINDELI